Attribution of Illnesses to Food Commodities

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Fundamental questions for food safety policy

- How much disease?
- Which foods?
- Where does contamination occur?

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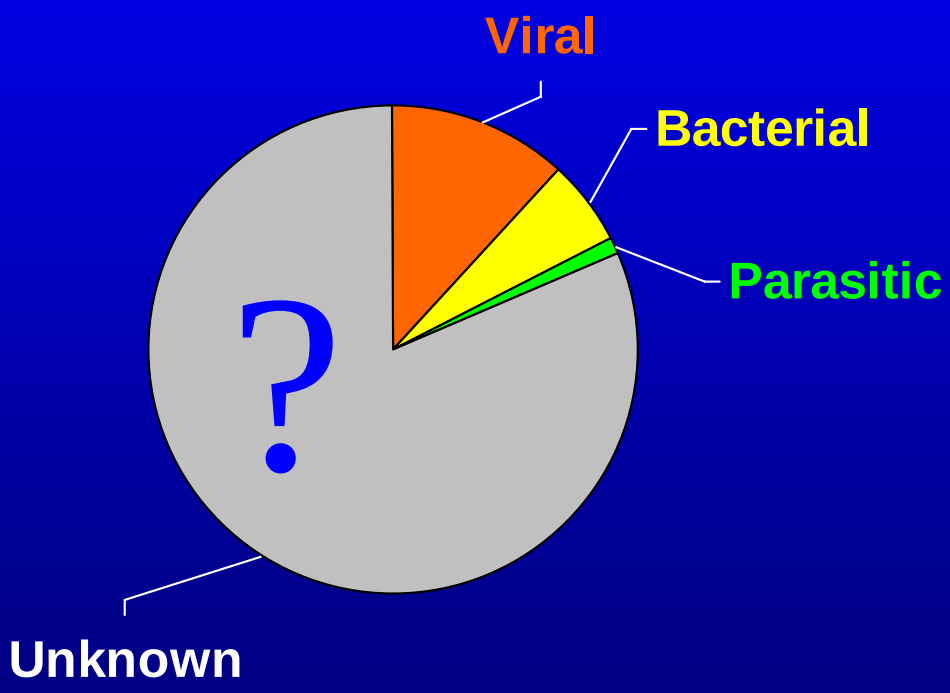
Food Attribution

- Attribute the burden of foodborne diseases to specific foods
- Prioritize food safety interventions and control measures
  - What foods are causing the most human illness?

Burden of Foodborne Illness in the United States

76,000,000 cases per year



Paul Mead, et al. Food-Related Illness and Death in the United States *Emerging Infectious Diseases* 1999:5(5); 607-625

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Allocating foodborne disease burden: many ways to slice the pie

- Food attribution can occur at different points along the farm to fork continuum

- Can be estimated from data collected at:
  - 'Pre-harvest'
  - 'point of processing'
  - 'Point of consumption'

CDC attribution efforts

- Start with human illness data
  - Attribute to different sources
- Approaches to Food Attribution
  - Epidemiological
    - Outbreaks and case-control studies
  - Microbiological
    - Comparison of human, animal and food subtypes

CDC epidemiological approaches to attribution

- Outbreak data
  - eFORS
- Case-control studies
  - FoodNet

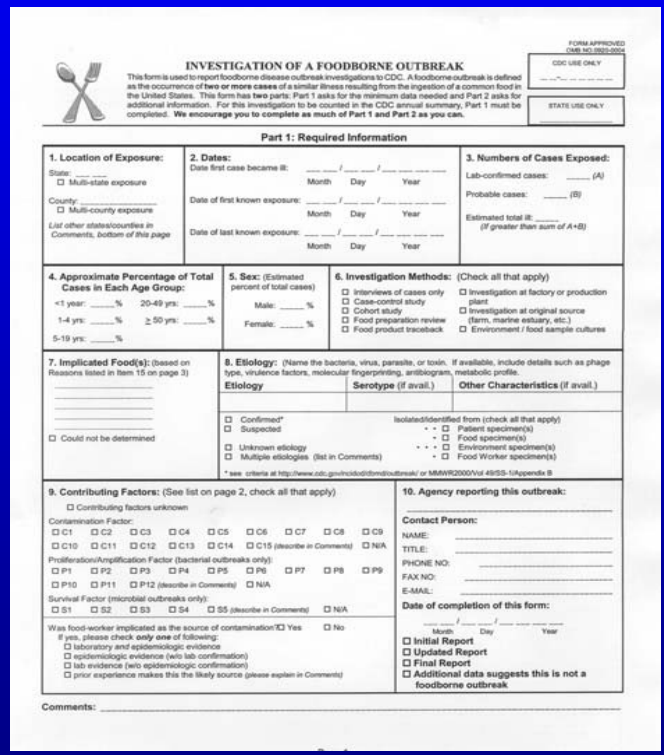
Using Outbreak Data for Attribution

Why use outbreak data to allocate illness by food commodity?

- For most pathogens, it is the only conclusive indication of which foods cause illness
- Represent, to varying degrees, all foodborne pathogens
- Represent a wide range of food vehicles
- Captures effect of contamination at multiple points from farm to fork

CDC Foodborne Outbreak Reporting System (eFORS)

- Web-based reporting system collects epidemiological information
- Approximately 1,300 reports per year
- From 1998-2004 generated a list of nearly 2,000 implicated food items



INVESTIGATION OF A FOODBORNE OUTBREAK

This form is used to report foodborne disease outbreak investigations to CDC. A foodborne outbreak is defined as the occurrence of **two or more cases** of a similar illness resulting from the ingestion of a common food in the United States. This form has **two** parts: Part 1 asks for the minimum data needed and Part 2 asks for additional information. For this investigation to be counted in the CDC annual summary, Part 1 must be completed. **We encourage you to complete as much of Part 1 and Part 2 as you can.**

CDC USE ONLY

STATE USE ONLY

Part 1: Required Information

1. Location of Exposure:
State: ☐ Multi-state exposure
County: ☐ Multi-county exposure
List other states/counties in Comments, bottom of this page

2. Dates:
Date first case became ill: ___ ___ / ___ ___ / ___ ___ ___ ___ (Month Day Year)
Date of first known exposure: ___ ___ / ___ ___ / ___ ___ ___ ___ (Month Day Year)
Date of last known exposure: ___ ___ / ___ ___ / ___ ___ ___ ___ (Month Day Year)

3. Numbers of Cases Exposed:
Lab-confirmed cases: _____ (A)
Probable cases: _____ (B)
Estimated total ill: _____ (*If greater than sum of A+B*)

4. Approximate Percentage of Total Cases in Each Age Group:
<1 year: _____% 20-49 yrs: _____%
1-4 yrs: _____% ≥ 50 yrs: _____%
5-19 yrs: _____%

5. Sex: (Estimated percent of total cases)
Male: _____ %
Female: _____ %

6. Investigation Methods: (Check all that apply)
☐ Interviews of cases only
☐ Case-control study
☐ Cohort study
☐ Food preparation review
☐ Food product traceback
☐ Investigation at factory or production plant
☐ Investigation at original source (farm, marine estuary, etc.)
☐ Environment / food sample cultures

7. Implicated Food(s): (based on Reasons listed in Item 15 on page 3)
☐ Could not be determined

8. Etiology: (Name the bacteria, virus, parasite, or toxin. If available, include details such as phage type, virulence factors, molecular fingerprinting, antibiogram, metabolic profile.

Etiology	Serotype (if avail.)	Other Characteristics (if avail.)

☐ Confirmed*
☐ Suspected
☐ Unknown etiology
☐ Multiple etiologies (list in Comments)
* see criteria at http://www.cdc.gov/ncidod/dbmd/outbreak/ or MMWR2000/Vol 49/SS-1/Appendix B

Isolated/identified from (check all that apply)
☐ Patient specimen(s)
☐ Food specimen(s)
☐ Environment specimen(s)
☐ Food Worker specimen(s)

9. Contributing Factors: (See list on page 2, check all that apply)
☐ Contributing factors unknown
Contamination Factor:
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8 ☐ C9
☐ C10 ☐ C11 ☐ C12 ☐ C13 ☐ C14 ☐ C15 (*describe in Comments*) ☐ N/A
Proliferation/Amplification Factor (bacterial outbreaks only):
☐ P1 ☐ P2 ☐ P3 ☐ P4 ☐ P5 ☐ P6 ☐ P7 ☐ P8 ☐ P9
☐ P10 ☐ P11 ☐ P12 (*describe in Comments*) ☐ N/A
Survival Factor (microbial outbreaks only):
☐ S1 ☐ S2 ☐ S3 ☐ S4 ☐ S5 (*describe in Comments*) ☐ N/A
Was food-worker implicated as the source of contamination? ☐ Yes ☐ No
If yes, please check **only one** of following:
☐ laboratory and epidemiologic evidence
☐ epidemiologic evidence (w/o lab confirmation)
☐ lab evidence (w/o epidemiologic confirmation)
☐ prior experience makes this the likely source (*please explain in Comments*)

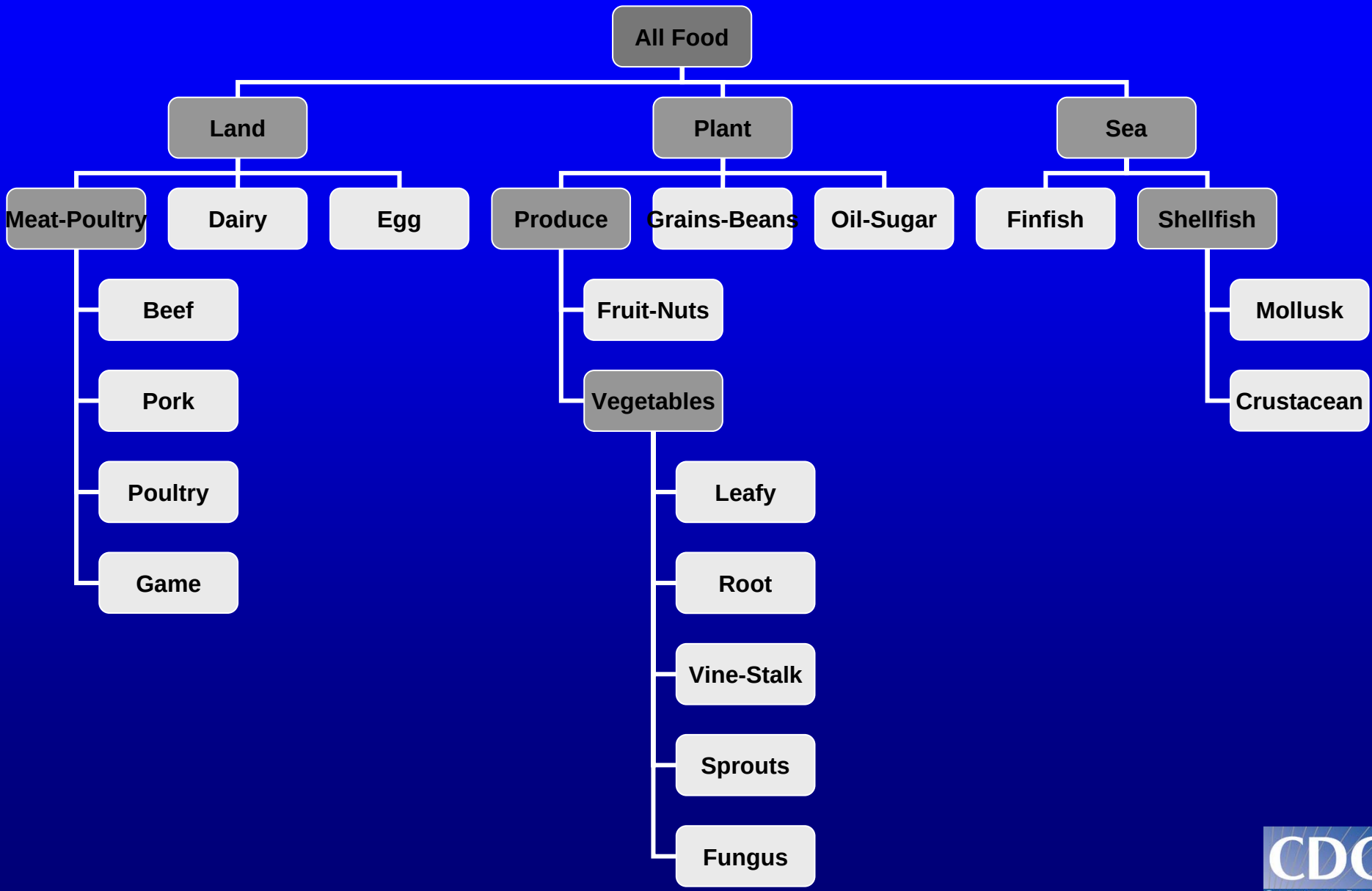
10. Agency reporting this outbreak:
Contact Person:
NAME:
TITLE:
PHONE NO:
FAX NO:
E-MAIL:
Date of completion of this form:
___ ___ / ___ ___ / ___ ___ ___ ___ (Month Day Year)
☐ **Initial Report**
☐ **Updated Report**
☐ **Final Report**
☐ **Additional data suggests this is not a foodborne outbreak**

Comments:

How to use outbreak data to allocate illness by food commodity?

- Group foods in to categories that make sense for industry and regulators
- For each pathogen,
  - Sum up total number of ill
  - Calculate percent ill for each food commodity
- Finally, sum up total ill weighted by burden of illness estimates for each commodity

Hierarchical scheme for categorizing food items into commodities



Hypothetical example summing all outbreaks (not real data)

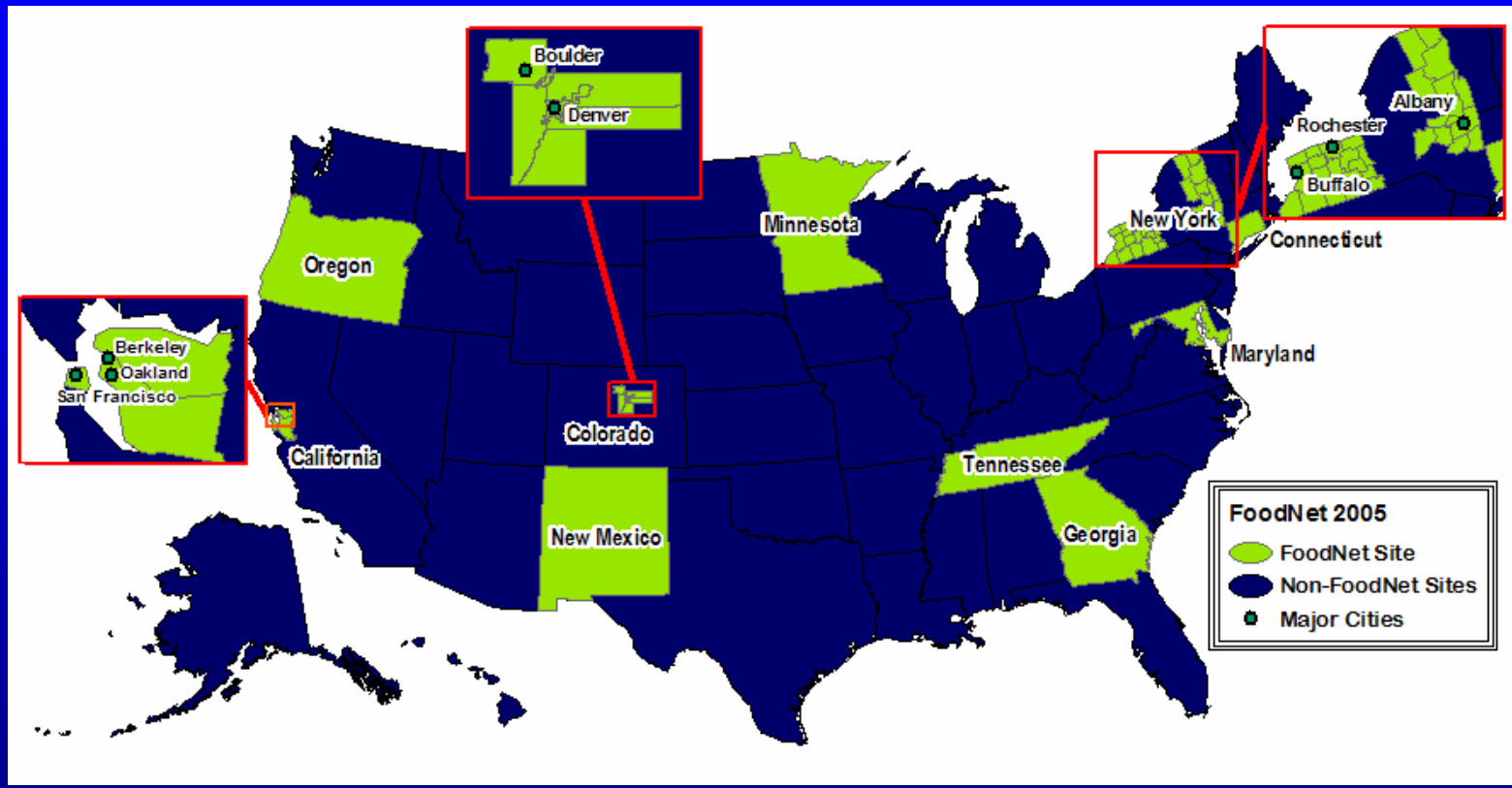
	Percent of illnesses in all outbreaks				**Total U.S. foodborne illnesses** (CDC 1999 estimates)
	Beef	**Pork**	**Veggies**	**Shellfish**	
E. coli	50%	0%	40%	0%	**62,458**
Vibrio	0%	0%	0%	95%	**5,122**
etc…..	⇓	⇓	⇓	⇓	…..
TOTAL	**%**	**%**	**%**	**%**	**14 million**

What are the challenges of using outbreak data for attribution?

- Most foodborne illness is sporadic, not associated with outbreaks
- Need sufficient number of outbreaks per pathogen
- Implicated food may not indicate implicated ingredient
  - i.e. Complex foods

Using Sporadic Case Data for Attribution

Foodborne Disease Active Surveillance Network (FoodNet)



FoodNet Sites 2005

44.1 million (15.2% of U.S. population)

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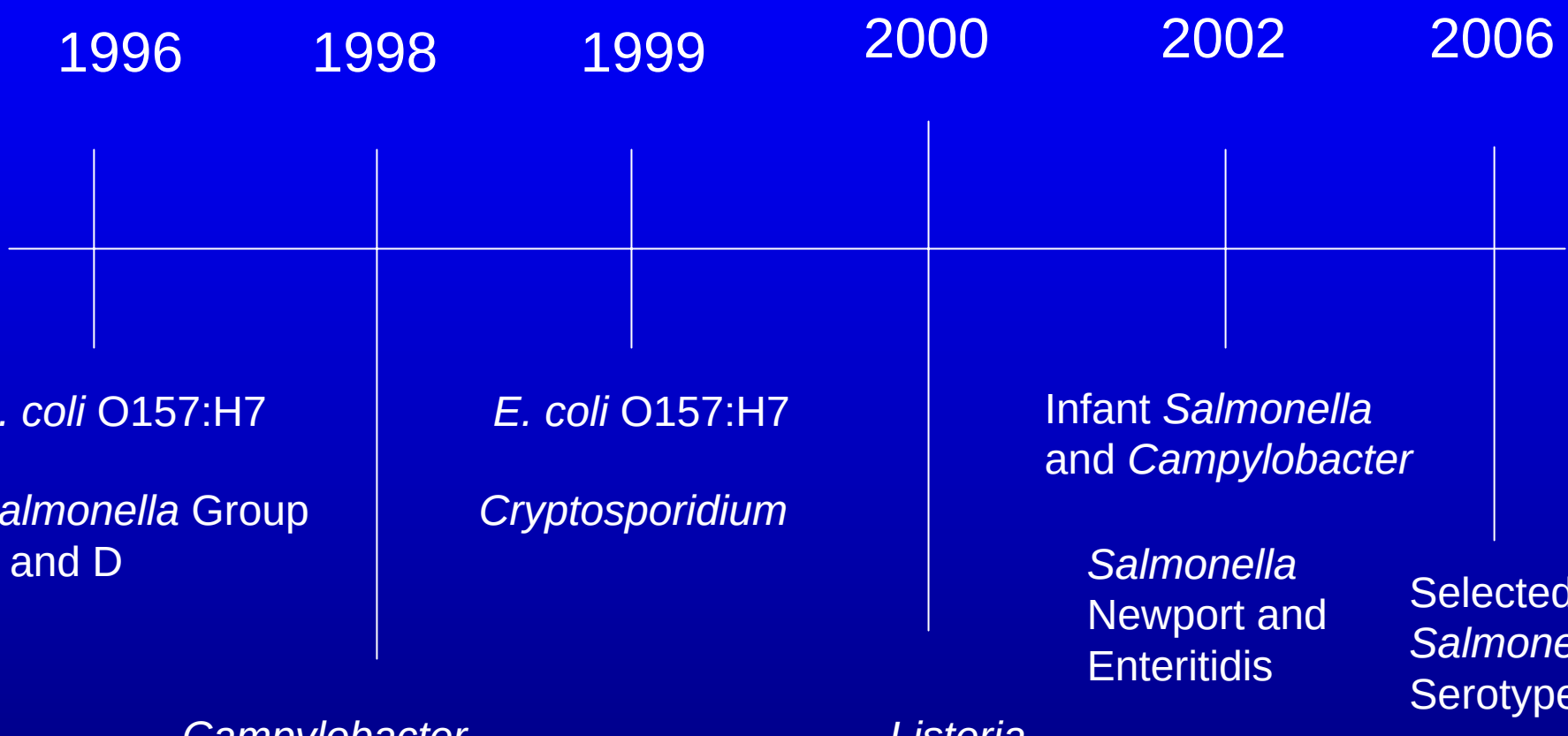
FoodNet Case-Control Studies



18 FoodNet case-control studies completed

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Driving prevention through studies of sporadic cases - *Campylobacter*

- **FoodNet: Case-control study data intake 1998-1997**

- **1316 confirmed cases and 1316 healthy controls (Outbreak-associated cases excluded)**

- **Risk Factors (Population attributable fraction):**
  - **Eating chicken or turkey at a restaurant (28%)**
  - **Eating other meat at a restaurant (21%)**
  - **Foreign travel (12%)**
  - **Contact with animal feces (6%)**
  - **Drinking surface water (3%)**
  - **Drinking raw milk (1.5%)**

Friedman et al., 2004. CID 38 (Suppl 3) S285-S296

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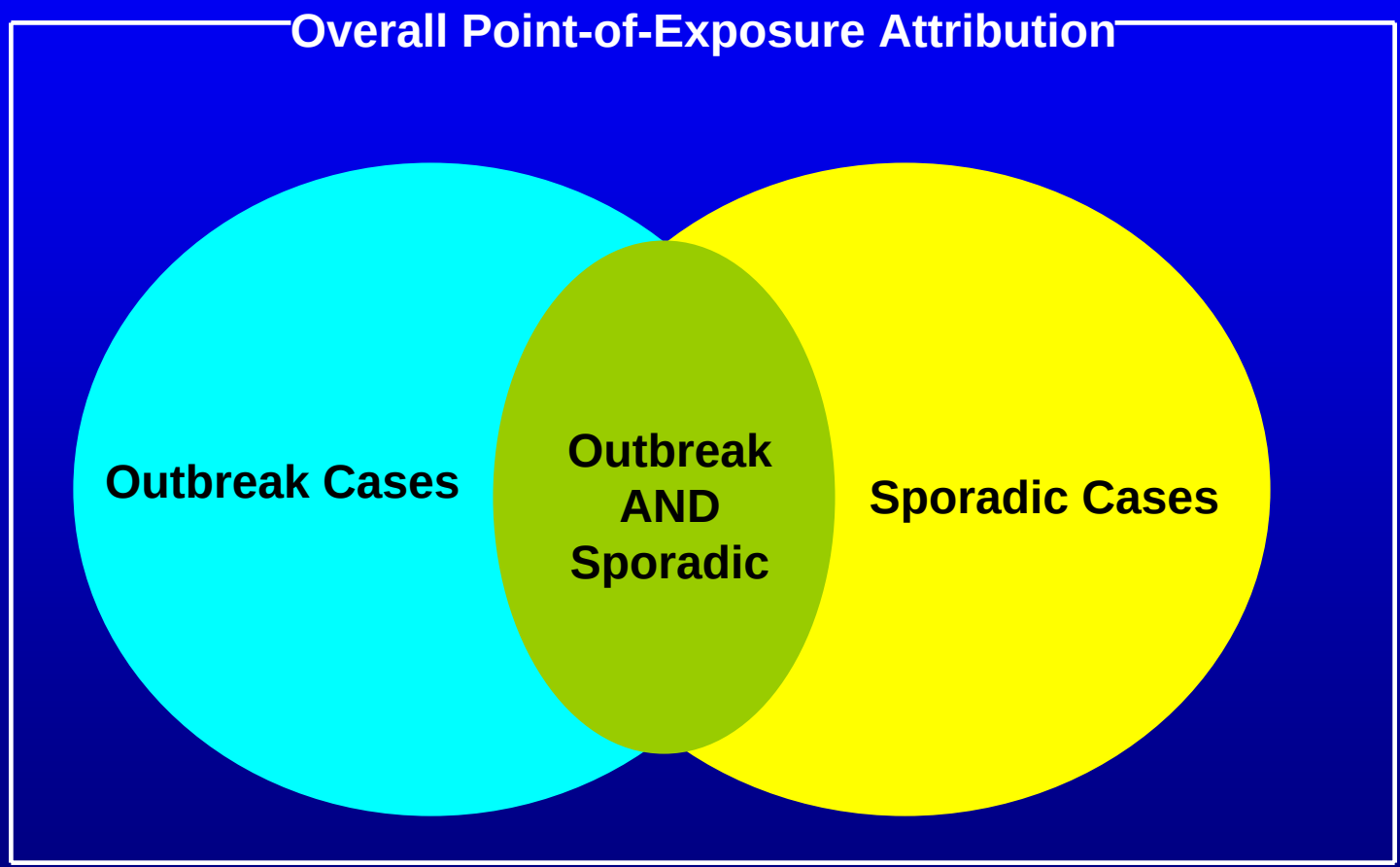
Blending project

***e.g. E. coli* O157:H7**

- Summary of outbreaks*
  - 20% due to eating hamburgers
  - 4% due to animal contact
- FoodNet sporadic case-control study
  - 15% due to eating pink hamburgers
  - 8% due to visiting a farm

***Rangel et al. EID 11:603-9, 2005**

Blending Attribution Project



Other groups working on food attribution

- Regulatory Agencies
  - USDA, Food Safety Inspection Service
  - FDA, CFSAN and CVM
  - Environmental Protection Agency
- Food Safety Research Consortium
  - University of Maryland
  - University of Georgia
  - University of California
  - Resources for the Future

Conclusions

- Variety of approaches used for food attribution
  - Data sources
  - Complementary approaches
- Data gaps identified
- Data sources to be used in the future
  - PulseNet
  - NARMS

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